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Aviation for Coast Defense

THE news that the Commonwealth of Australia has decided to build a naval air fleet, which is to consist of six squadrons of twelve airplanes each, affords an insight into that country's thoughtfulness. Having a surface area nearly as large as the United States, but with a population of only 5,000,000, Australia naturally cannot afford to maintain a surface fleet that would be adequate to defend its extensive coast line against foreign invasion. But the low production and maintenance cost of aircraft advantageously solves the problem of cheap coast defense.

The experience of the late war and, even more so, the success of the recent bombing raids off the Virginia Capes prove that airplanes and seaplanes are capable of effective action as well as of observation and the attendant protection work, permit. It is not oversteering the case to say that when bombing and torpedo-carrying airplanes or seaplanes will have been fully developed, a country possessing such machines in adequate numbers with a properly trained personnel will be enabled to successfully defending its coast line against any naval attack. Of course, to make such a coastal aviation fully effective it must also comprise the necessary proportion of observation and patrol machines.

The production, since made in the past, that the airplane would eventually become the definitive weapon par excellence of nations which cannot shoulder heavy armament expenditures thus seems to become true. In the past the smaller maritime countries found it necessary to keep a weakness of a fighting fleet in the shape of coast defense monitors, patrol cruisers and destroyers, which often were acquired merely to reduce the expense. The best such vessels were capable of doing was to show the enemy's flag in foreign ports, for any first class navy would have sent them in the before with little loss to itself. These third rate navies were therefore rather an expensive ploy to the countries involved, considering that their actual value for national defense was as the neighborhood of nil. But now the advent of effective aircraft promises to change this situation. Small countries which in the past had no means of adequate defense against a powerful adversary now find in the airplane the very weapon they were lacking for. It is effective and cheap, and besides it soon becomes obsolete. The latter point naturally prevents the building up of a huge air fleet through the accumulation of older types and thus every country large or small, has an equal chance to build up and to maintain its efficient coast defense aviation.

Australia is not alone to have perceived this truth. Several South American countries are making a strong effort to put their coast defenses on the aerial plane, so is Spain, and the Netherlands, among others, are building up an up-to-date air fleet for the protection of the Dutch East Indies.

The Monoplane Is Retaining

IT is becoming increasingly evident that there is a distinct tendency among aeronautical engineers to return to the monoplane type, at any rate for single-engine machines. The reason for this reversal of policy is that the tractor biplane has been brought to such a state of efficiency that a better performance can only come from wing sections embodying much better L/D characteristics than are now available. While several new wing sections of supposedly superior design are under development, these have not as yet emerged from the experimental stage. Hence the monoplane offers a much more immediate field for improvements of performance.

Owing to the lack of interference such as occurs in superimposed or broken wing arrangements the lift of a monoplane wing is about 20 per cent more efficient than that of a biplane. If, then, the present monoplane is as good as a monoplane, then in a biplane, the former type naturally becomes the favored machine.

Now, in a biplane the main portion of the parasite resistance is represented by the struts and was broken which hold the wing cells together. In a monoplane this parasite resistance can either be greatly reduced or else entirely done away with by using semi-cantilever or full cantilever wings. The Landing monoplane represents the former system; the Junkers and the Fokker the latter.

In either case the monoplane type has proven to be greatly superior in performance to biplanes of the same wing loading and power loading. It operates the means that a monoplane can either carry the same load as a biplane with less horse power, or that with the same horsepower it can carry a greater load or have a better performance.

The importance of this development is obvious insofar as commercial aviation is concerned, for it tends to make more economical the operation of civil airplanes.

The cantilever monoplane has, with respect to the biplane, some further advantages which mainly concern the comfort and well-being of the passengers. With the wings fitted flush with the top of the fuselage the access into the cabin of a monoplane is as easy as stepping into a locomotive. On the other hand, in flight the passengers enjoy almost unrestricted views downward, which adds to the pleasure of flying. The experience of the European airways seems to prove that actual passengers are, particularly on long flights, subject to spells of boredom which even the comforts of up-to-date cabins do not succeed in offsetting. It has been found that the most disgruntled passengers are in general those whose views of the outside world during the whole flight is limited to an engine mounting or to a couple of struts, when they would be free to watch the farmhouses and railroads, the houses and lakes, etc. These may seem trivial details, but if aerial travel is to be made attractive to the prospective passenger, such details should not be overlooked.

At a meeting held in Washington, D. C., some time ago a syllabus of a proposed Aeronautical Safety Code was presented. This code is understood to be prepared by the Bureau of Standards. The following representation of various organizations interested in the problem were invited and most of them were present.

Society for Automotive Engineers. David Brewster, Pres.; C. F. Gardner, Gen. Mgr.; Glauco L. Martin, Member of Council; L. M. Griffith, Member of Aeronautics Div.; John R. Campbell, Meetings Committee; Prof. E. F. Warratt, Mass. Institute of Tech.

Bureau of Standards. Dr. S. W. Stratton, Director; Dr. E. R. Bower, Chief of Div. 1; Dr. A. J. Briggs, Chief of Div. VII; Dr. H. C. Dickinson, Chief, Power Plant Sect.; Dr. M. G. Lloyd, Chief of Safety Section; Mr. Arthur Holcomb, Safety Section.

U. S. Navy Department. Commander Kenneth Whiting, Aeronautic Operations.

U. S. Post Office Department. Maj. E. C. Zell, Gen. Supv. Air Mail Service.

U. S. War Department. Maj. Walter R. Weaver, Air Service; Maj. Harold Harney.

National Advisory Committee for Aeronautics. Dr. J. S. Ames, Chairman of Executive Committee; G. W. Lewis, Executive Secretary.

National Aircraft Manufacturers Association. Mr. Ely, President; A. Hylen, Manager.

National Safety Council. Gen. E. F. Peterson, President; J. C. J. G. Rausch, Treasurer; J. C. J. G. Rausch, Treasurer.

Aeronautical Laboratories. A. R. Small, Vice Pres. Manufacturers Aircraft Association; S. B. Bradley, General Manager.

American Engineering Standards Committee. Dr. A. S. McAlister, Acting Secretary.

While the report was discussed both fervently and unreservedly it is being pointed to indicate the length to which such standardization and regulation can go even in so great a character as to be as sensitive. Some of the members feel that if such a code is not prepared immediately, some less informed organization may take notice of it. It is felt by many that the time has not come yet for such a code but it affords suggestions which will be read with interest.

AMERICAN AERONAUTICAL SAFETY CODE

Proposed Divisions

INTRODUCTORY PART

Scope and application of the rules; Exceptions; General requirements; Nomenclature; Definitions.

PART I. AIRPLANE STRUCTURE — DESIGN, CONSTRUCTION AND TESTS

Design of airplanes; Arrangement; Construction; Wind tunnel; Static and flying tests; Inspection; Specifications for materials and parts; Minimum factors of safety; Stress calculations.

PART II. POWER PLANT — DESIGN, CONSTRUCTION AND TESTS

Design of power plant; Construction; Fuel tanks; Fueling; Lubrication; Ignition; Cooling; Exhaust; Auxiliaries; Engine controls; Inspection and tests; Specifications and tests for materials; Factors of safety.

PART III. EQUIPMENT, MAINTENANCE AND OPERATION OF AIRPLANES

Instruments; Safety devices; Lights; Inspection; Maintenance; Repairs; Stages; Marking; Log records.

PART IV. SIGNALS AND SIGNAL EQUIPMENT

Signal equipment for landings and airports; Flags; Lights; Beacons; Radio; Signals.

PART V. LANDING FIELDS AND AIRPORTS

Classification; Size; Markings; Building construction; Equipment; Beacons.

PART VI. TRAFFIC, FLYING AND PILOTAGE RULES

Rights of way; Flying over cities; Track and obstacles; Flying; Ballast; Take-off; Landings; Aeronautics; Control.

PART VII. QUALIFICATIONS FOR AVIATORS AND AERONAUTS

Physical Qualifications; Experience; Technical knowledge.

PART VIII. BALLISTICS, PARACHUTES, KITES, ETC.

Design and construction of balloons; Inflation; Equipment; Inspection; Maintenance; Log records; Traffic rules; Design and construction of parachute; Miscellaneous; Operations.

PART IX. AIRSHIPS — NON-RIGID, SEMI-RIGID AND RIGID

Design and construction of non-rigid, semi-rigid, and rigid; Airships; Inspection; Tests; Specifications for materials; Equipment; Instruments; Maintenance; Inflation; Operating rules; Mooring; Log records.

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521. Tests, Inspection and Maintenance of the Power Plant
522. The Design and Construction of Tanks
523. Piping Systems
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530. Engine Controls

Sec. 54. Tests, Inspection and Maintenance of the Power Plant

Rule 530. General Requirements for the Power Plant
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532. The Design and Construction of Tanks
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Papers read at the Joint Session of the A.S.M.E. and the S.A.E.

In the July issue of the *Journal of the Society of Automotive Engineers* appears an interesting paper on the subject of the requirements of aerodynamic development, written by Messrs. G. J. Moore and L. J. Fugate, mechanical Engineers with the Wright Aeronautical Corporation of Paterson, N. J. This paper discusses the probable trend of development of aviation engines, showing the reasons for the types which are likely to become more or less standard.

After reviewing the development of the various types of engines and analyzing the effect of their characteristics on airplane performance, the authors, in summarizing the situation, state that we have not reached the limiting case for any type of engine as regards the maximum power available.

No increase in engine performance can be expected unless new materials of construction, new fuels or new cycles of

commercial work, due to its effect on the profits of an operating company, and should be given study by the military authorities also, on account of the effect it has upon the question of fuel required in case of hostilities. This is, in our minds, the best and most obvious reason why the power requirements for aeromarine outpropellers should be reduced rather than increased. It is not commercially possible to build an army power plant within a given range. Airplane designers must be satisfied with fewer units, if we are to be concerned in the long run.

It is believed that the effect of engine dimensions on maneuverability is largely unaccounted for. The reason that popular opinion is so often in the effect that the engine is the most important factor is the fact that there is no ready means by which the aerodynamic qualities of the airplane affecting maneuverability can be thoroughly analyzed and visualized. For similar horsepower engine type rather than overall size will have the greatest effect on the potential drag of the fuselage group. The efficiency of the cooling-fixture design for water-cooled engines is considerably better than that for air-cooled engines. Between practical limits, the effects on the performance of the airplane of variations in the values of engine weight per horsepower, of cooling efficiency, of fuel

In connection with the joint work of the Aeronautic Division of the American Society of Mechanical Engineers and the Society of Automotive Engineers to the Air Service Station at McCook Field, May 11, a very interesting technical program was presented by the members of the Field's staff. Joseph A. Bonanza, Chairman of the A.S.M.E. Aeronautic Division provided. Brief summaries of the eight papers read immediately follow.

Aluminum Cylinder Castings

Discussing this subject, R. H. Dix stated that a satisfactory lead between the steel cylinder and the cast aluminum head was formed with either sheared or turned steel cylinders. Shear finish was decided upon because of the higher seating point of steel.

The problem of an alloy for valve-rocks inserts and spring lockings was solved by the adoption of a rolled phosphor bronze containing 2% lead, not too close because its coefficient of expansion is approximately that of aluminum.

The next step after these preliminary experiments was to make the casting. This was made up using dry sand cores made and outside. Three overflow cores were placed to allow for the pouring of metal into the mold.

Metal was poured through the mold so as to heat the cylinder and prevent the warping of the aluminum during its pouring. However, the first casting showed a serious axial crack just over the inlet valve. A second effort was made to get out a casting and inside of the cylinder. This was done by sand casting pattern. In this case, however, the core was severely heated before pouring, and the whole mold was placed in a new oven at 300 deg. Fahr. immediately after pouring and allowed to remain for a day and a half. This eliminated the cracking around the steel cylinder, but a crack developed in another place, that is, between two of the valve-seat inserts. It is believed that these difficulties can be overcome by slight changes in the method outlined, although producing the mold and the subsequent sanding would make a rather expensive production job.

It has therefore been decided to endeavor to find an alloy which is less liable to crack than the one previously used which was 7 per cent copper and 1 per cent tin, and the aluminum, first being recommended from the experience gained in England on a similar proposition. To make in this selection, a hot-shortness test was devised. This consists in cutting a test bar around steel rings fixed 12 in. apart. The first three bars used in this comparative work contained alloys containing 4 per cent copper, 50 per cent tin and 7 per cent copper and 1 per cent tin, respectively, and these all cracked. The fourth bar is a silicon-aluminum alloy on which the Material Section is experimenting at the time. This bar showed no crack when cut in this manner. Arrangements are being made at the Bureau of Standards to have coefficient-of-expansion tests made on this alloy.

It is pointed out that he had mentioned very briefly a problem now of very vital interest in the Air Service and of which no more than the surface had been scratched, and he hoped by so doing an interest might be stimulated among those present which would result in valuable suggestions for future work at the Field in this connection.

Air-Cooled Airplane Engines

In his treatment of this subject, S. D. Hanna pointed out that the advantages of an air-cooled engine for military purposes were the fact that it was less liable to fire, cooling down and never during hard drives, and overhauling due to a deep crack is temporary. The air-cooled engine, however, has not reached the finality of design of the best water-cooled engines, although progress has been made. It is, of course, well known that the best water-cooled practice in power, brake and efficiency

pressure, and exhaust-valve reliability. Fuel economy with maximum power mixture is from 15 to 20 per cent less than in the best water-cooled engines. The advantages of the air-cooled engine have been shown in service when meeting a maximum of skilled attention. They have given good results in the Egyptian desert, and in the Egyptian desert.

In most designs of a cylinder for the cooled engine, a compromise between cooling efficiency and proper valve operation is evident. The speaker pointed out that in the air-cooled cylinder shape and lightness have been compromised, while the cooling result has not been suffered. The resulting design would not be selected in a high-class water-cooled engine.

As to V engines, twelve-cylinder types up to 240 h.p. have been constructed satisfactorily and have given good service. The valve operation of this type is complicated because of the location of the exhaust side of the cylinder relative to the air line.

Dealing with the question of cylinder design, Mr. Hanna described the results secured by the British with the spherical combustion head and as referred to an integral head steel barrel. He presented data showing a number of tests of air-cooled engine cylinders which show that the highly efficient cylinder has not a low weight per cubic inch of swept volume. He illustrated one of the largest and most powerful air-cooled engines now in use, the A.E. 12, with 8 in. bore and 16 in. stroke and developing 129 h.p.

Carburizers for Aircraft

The carburetor problem of aircraft engines were outlined by C. Webster Taylor in his remarks. A new simple type of carburetor can be utilized in airplanes that is satisfactory, the open-tube type with some form of automatic valve being the most common. Most aircraft engines carry from two to six carburetors, which constitutes a problem in obtaining uniform adjustment and synchronization. This provides the uniform mixture for all cylinders, and the carburetor valves are therefore the rule. The necessity for operating under extreme variations of temperature and pressure requires that the fuel-mixing system must be large enough to take care of the load during the most severe conditions in which the engine will operate. A manual control is therefore provided.

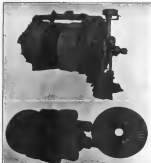
Extreme variation from the horizontal position brings about a severe condition for the aircraft carburetor. This condition is met by carefully locating the fuel chamber in relation to the fuel supply and the carburetor.

In order to reduce the fire hazard, the carburetor air intake must project outside the engine nacelle. This means that the aircraft carburetor must take its air from a slip stream traveling from 100 to 200 m.p.h.

Aluminum Castings

The purpose of color knowledge for airplanes as stated by Gerald P. Young, is to break up the outline of the plane. The coloring of the entire surface is a combination of tan, blue, green and purple. The general scheme followed is to divide the surface into three irregular areas of color covering boundaries, applying these three colors both to the upper surface of the top wing and the upper surface of the lower wing. The same colors are brought back along the bottom surface of the wing and the bottom surface of the plane in thin visible when observed from above, and a tail section, blending with tan earth colors, cause it to become practically invisible, leaving only the darker colors which, when viewed irregularly, throw the eye off from the general outline of the plane. This is the observer to lose the plane in the background elements.

This system is of value for planes left in the open air flying fields or when parked in the field at night, and also for cam-



A HORIZONTAL TYPE ENGINE. THE 196 H.P. ALMEN 7 CYLINDER ENGINE.

operations are made available. Continued development will refine the practices of the art and result in bettering the life of the engine and the service it renders, rather than its performance. Therefore, increased airplane performance must be secured mainly by improvement in airplane design. Great advance seems to be possible in this direction. One reason for the tremendous powerplants available for airplanes has been the efforts to secure performance by their strength. Aluminum has not been reached in this trend of development engines. It is certainly worth while to consider what can be done with a reasonably good powerplant, by allowing the design of the airplane. As shown in the last picture here, current horsepower is not sufficient to secure high speeds. The next few years should see a reduction in the power demanded of present engines.

It is high time that attention be given to a most important problem, the fuel release obtainable from a given airplane. It is unquestionably true that the average powerplant could not afford to operate some airplanes, even though he might be able to purchase one, because of the poor mileage secured from a gallon of fuel. This is an essential consideration for



AIR X TYPE ENGINE. THE 1,000 H.P. NAPIER "X" 16 CYLINDER ENGINE.

economy and of altitude performance of the engine are very pronounced. The demands of super-performance in military designs and greatest operating efficiency in commercial designs will require the development of engine types which are most favorable in these respects. The relative importance of the factors involved is governed by the particular service for which the airplane is designed.

Problems of powerplant installation are centered about the need of a close cooperation between the builders of airplanes and engines. The requirements of each system of installation can be met only by acquiring a correct knowledge of what these requirements are and satisfying them fully. A study of the engine mounting in complete detail, developing the frame frame to accommodate all of the engine forces involved, both static and dynamic, is a most important requirement in securing a successful installation. Simplicity and practicality of design and the suitability of the necessary equipment used are most essential in the development of the several powerplant installation systems.

The development of the complete powerplant installation must be made with a view to permitting the greatest possible degree of service flexibility. Only in such a way can the proper mechanical situation be secured for the powerplant. The fact that he has said of that the designer is in a formative period and for this reason we must expect to need a tremendous amount of time and money in research. We cannot standardize without knowledge, and we cannot obtain that knowledge without research.

* Courtesy Mechanical Engineering

coming balloons flying at low altitudes and observed by ground stations from above.

The outer surfaces of planes are encased to give a light reflecting surface and the interior scheme is burnished aluminum, light blue, light purple and white. This system makes the plane look like an airplane especially when in deeps and clouds having a light purple color and visible at altitudes up to 17,000 ft., to become invisible at an altitude considerably under 10,000 ft.

Radio Communication

Dealing with this subject, G. E. Marvel described the characteristics of systems to be transmitters and the vacuum tube, the one thing that made the radio telephone possible. He explained that all airplanes radio sets are now designed for telegraphing and continuous wave telephony. He emphasized the importance of radio communication, especially in military work, such as wireless control, infantry contact work and reconnaissance. He also emphasized the importance of wireless in direction finding—used during the war to locate enemy radio stations and to navigate aircraft.

Airplane Radiators

Lieut. Bayard Johnson spoke on the subject of airplane radiators. He pointed out the fundamental difference between the problem of radiation on an airplane and on an automobile engine, emphasizing the large volume of water which must be forced through the airplane radiator and the need for concentrated flow. The standard radiator core used by the Air Service is made of standard round copper tubes having 1/2 inch outside and 3/8 inch inside diameter. Flow, has no internal soldered joints, can be easily installed.

International Air Navigation Congress

Under the patronage of the French Under-Secretary of State for Air, the French Chamber Syndicale des Industries Aéronautiques has taken the initiative in sponsoring an International Air Navigation Congress, to be held at Paris, France, in 1933. The Congress will be held at the Hotel de Ville, Paris, on September 18, 1933, to afford an opportunity of discussing the various problems connected with international air navigation. The President of the organizing committee is P. E. Flandin, late Under-Secretary of State for Air, who will be assisted by a number of well-known French experts as vice-presidents. The President of the Technical Committee will be H. Serron, who is President of the Aviation Commission of the French Aero Club. The Air Navigation Committee will be under the presidency of Colonel Gousseny.

By arriving at conclusions from all interested in the question of commercial aviation, it is hoped to establish an interchange of ideas which will be of great help in the furtherance of aviation all over the world, and give an opportunity of discussing such problems as the future development of international flying. Those who wish to help in any way toward the success of the Congress can do so in two ways:—by becoming full members or by becoming associate members. The fee charged for the former is 40 francs and for the latter 20 francs. Full members are entitled to send in communications to the Congress, and will also receive a stamp of the communications. Associate members are not entitled to send communications, but will be able to take part in any discussions held, or in practical demonstrations at Le Bourget, etc. Payment should be by cheque or money order, made out to the Chamber Syndicale des Industries Aéronautiques, 45 rue Assoluto de la Fierge, Paris (XVIII). At the conclusion of the conference the proceedings will be published in full, and a copy of the published report will be obtainable by associate members as well as full members for the price of 50 francs.

Printed forms of application for membership, as well as lists of names of papers or communications which it is intended to submit to the Congress, can be obtained from the General

in light and is most effective for air speeds of 80 m.p.h. and over. In discussing the location of a radiator he emphasized the necessity for a support as free from vibration as possible. Comparing relative values of frontal, wing, landing-gear and side radiators, the advantages of the side radiator was shown, as they are protected from damage and have both air speed available. Although the pricing is long it is considerable advantage the pilot hands. He also emphasized the need for accurate information as to the performance of different types of radiators and stated that the Engineering Division of the Air Service was progressing favorably in obtaining this information.

Aerial Photography

In discussing aerial photography, Capt. G. W. Stinson described different types of film and plates and showed the film in rolls permitting 300 exposures, which does not require loading, heavy cameras and is not subject to shattering or breakage, is more desirable for aerial photography. His suitable ray return to eliminate haze it is possible to get good negatives from heights of three to four miles. A camera specially designed by Major Rogers of the Corps of Engineers has three lenses, making one vertical and two oblique exposures at the same time. At an elevation of 15,000 ft. it takes an area 3 miles wide. With the mechanism ordinary film can be used easily for many country with an exposure of but 200 ft. in 1/500 sec. The use of the camera in mapping was explained by the speaker, who showed a slide of a scene of the city of Rochester made up of 33 exposures.

Captain Stinson also explained the need for oblique and vertical pictures which view through the proper apparatus come the ground detail to stand out in relief.

Secretary, International Air Navigation Congress, 3, Rue Assoluto de la Fierge, Paris (XVIII).

Communications should be kept as short as possible—about 2,000 words will be a suitable length. Letters should be typed on one side of the paper only. Line drawings accompany the communications, but they should be carefully drawn, and the space available for their reproduction is limited. The two pages of the Congress program, containing all papers should be submitted before Oct. 25, 1932, so as to ensure a reprint being printed in time for the Congress. Papers which arrive after that date will not be published. The papers, after the Congress, of the French Aero Club and communications may be written in either of the following languages—French, English, German, Italian or Spanish.

With regard to the papers submitted, these should bear one of the following subjects:—

- (A) Technical Committee
 - (1) The utilization of results of wind tunnel model tests for full-scale calculations.
 - (2) Airplane and airplane components or empennage. Thick and thin wings. All-metal structures and composite structures.
 - (3) Airships with great carrying capacity.
 - (4) Commercial air engines, their arrangement in the machine and their transmission gear and ground or air use.
 - (5) Apparatus for fitting the position of an aircraft and of training its route.
- (B) Air Navigation Committee
 - (6) Air routes—Outline, management, wireless, meteorological information, aerodrome installation and ground or air use.
 - (7) Commercial aviation—Commercial machines, airplanes or airplanes, passenger, goods, and mail machines. Charts, organization and exploitation of regular air lines.
 - (8) Air legislation—Regulations, Customs, Examination of personnel and material. Safety. Insurance.

The Imber Safety Tank

Statistics show that quite a percentage of fatalities due to airplane accidents were caused by reason of the fact that the gasoline tank exploded upon impact with the ground, setting fire to the plane, the occupant thereof succumbing to the flames before he could extricate himself from the wreckage.

Jack Imber of London, England, has invented a fuel tank for airplanes which it is claimed is proof against leakage in the event of its being punctured and proved against fire when passed by incendiary bullets or other projectiles. It appears that a small bullet can inflict extensive damage when passing through a fuel tank. In many cases it has been found that an incendiary bullet will tear a hole 6 or 8 in. in diameter in the side of the tank opposite to that through which the bullet enters. This phenomenon has perplexed many inventors who were seeking to prevent the gasoline from leaking from bullet holes. Investigation disclosed that the larger hole was due to the enormous pressure of fuel against the far side of the tank. On entering the tank the pressure of the fuel is partly arrested by the liquid and set up in the liquid a pressure which increases both in area and force from the point of entry to a distance of approximately 2 ft. 6 in. Thus when a bullet travels through a tank its pressure is reduced, but on the other hand in a tank of ordinary size it is found that up to a certain point the farther one side will a from the other the larger will be the hole torn upon the exit of the bullet, because the pressure were in the liquid in the main cause of the larger hole torn at the exit.

The Imber principle is to allow the energy of the pressure wave to dissipate by protruding the tank with a resilient rubber covering, in that when the pressure exceeds a certain point the tank yields and the rubber stretches out from the side of the tank under pressure. Naturally the highest point on the stretched rubber covering is that through which the bullet makes its exit, and the rubber being stretched makes the point also the thinnest portion of the covering, so that when the bullet leaves and the pressure is relieved the rubber soon takes its former shape and completely closes up and seals the bullet hole.

The Imber tank is composed of three parts, as shown herewith.

Aluminum framework in which stretch aluminum buffer-plates are attached, which framework is adapted to fit within and conform to the shape of the shell; the metal shell or casing, made of dished sheet, into which the buffer-plate frame is inserted, and the outside rubber covering which conforms to the entire shell. The resilient or elastic covering conforms to its seating against the framework in such a brief space of time that it is impossible for the contents to spillover in the event of the projectile being of an incendiary nature. The outer rubber covering is of specially prepared rubber, approximately 1/2 in. in thickness. The edges of the tank are reinforced with an additional rubber strip, 1/2 in. thick, reinforced to the covering rubber.

When shells are, of course, taken out of by the rubber covering, but when a hard blow is struck the internal construction gives. While the framework is strong enough to give adequate bearing to the tank under ordinary usage, it is purposely made collapsible upon the application of a blow likely to cause a puncture. In the case of a landing in which a weak corner, the rubber covering retains the petrol, as matter how badly the tank may have been battered. While the framework of an aircraft may collapse and strike fatally against the tank or the tank strike the ground, the result will surely be a distortion of the shape of the tank, thereby increasing the danger of fire from the inflammable liquid that otherwise would have been sprayed about the wreckage.

To prove the efficacy of these tanks in the proximity of fire a test was recently carried out on a Serravallo Camd machine fitted with the Imber tank. Arrangements were made to effect a dive, which was brought about under cover of a dished. The machine was dropped from the airship H-13 from a height of about 1,500 ft. with the engine running. After the crash it was found that the engine, back plate and controls were forced back to the main tank, the cylinders being quite hot enough to vaporize gasoline had the tank burst. The pilot's seat acted as a buffer, and the blow, in addition to shortening the tank, caused a slight tear of the rubber cover, but there was no spray or leakage of gasoline.

Early Aviation History - I



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Unlicensed Flying

The following account from our British contemporary *Flight* of the proceedings against a pilot for an offense under the Act and Regulations relating to aerial navigation will, we feel, be self-explanatory as to why aerial navigation is on a sound basis in that country when compared to the haphazard manner in which it is being handled here.

On August 13, before the Croydon County Bench, Capt. E. D. C. Horne was summoned as the captain of the trimmer for three offenses under the Act and Regulations relating to aerial navigation. He was charged with: (1) flying an Aero biplane from Croydon to Newmarket on June 27 without any license as a pilot to fly passengers or goods afloat; (2) with carrying two passengers to Newmarket on the same date without his machine having been certified as airworthy; and (3) with flying on July 21 with passengers from Croydon to Cardiff without his machine having been inspected before the flight by a competent person licensed for the purpose.

The prosecution said that people taken up as passengers knew that the Air Ministry controlled civil aviation, and naturally supposed that the regulations for their safety were being observed. The defendant was summoned for completely ignoring them, for he had no license of any valid sort on the day he took two passengers to Newmarket, June 27. His last license before that expired on May 15, and a letter was sent calling attention to that fact he ignored it. One of the things necessary to the granting of a license was medical examination; 90 per cent of the accidents happening in the air were due to some weakness in the condition of the pilot. The defense contended that point, and demanded that evidence be called in support of it.

Considering the prosecution said that if there had been any defect on account of the defendant's health it might have resulted in the passengers losing their lives. The defendant took one another license on July 1, when he satisfactorily passed the medical examination.

On the second summons relating to the airworthiness of the machine on June 27, the prosecution said that the last valid certificate as to the airworthiness of the machine before the date in question was March 12.

An inspector of aircraft testified as to certain defects he noticed in the machine on July 25, including the frayed condition of the control wires.

The defense said that if there were really a weakness for protecting the safety of the public he would call evidence to show that there was no safer pilot than Captain Horne. He had flown the equivalent of many times around the world, and had never damaged a person or a machine. What the Air Ministry was doing, the defense suggested, was to protect certain big flying companies who objected strongly to what they called the "haphazard man," and desired to freeze him out. The defense submitted that the offense, if any, was the point of technicality, and pointed out that this matter concerned the actual livelihood of the defendant.

The defendant, giving evidence, declared that on June 27, from an ordinary common sense point of view, the machine was in absolutely perfect condition, but he had not applied for a certificate because the machine had been standing by since March. Reference to the alleged defect in the machine, he added, that he would be unable to take his machine up with the controls frayed in the manner described. "There is not a machine in existence on which you could not put your finger on outside frayed somewhere," he observed.

Dealing with the third summons, the prosecution said that the defendant received £29 (£150.00) for taking passengers to Cardiff. His machine not having been inspected before the flight. The following day he endeavored to persuade some of the ground men to give him a certificate dated the previous day.

The defendant explained to the bench that his machine had completed the flight perfectly, therefore it was obvious that it was airworthy. He asked for a certificate, which, owing to their being no ground-crew about, he could not get on the previous day, without any wrongful intention.

Defendant was fined £19 (£50) on each of the three offenses, with £19 7s. (£52.00) costs, £16 15s. (£52.00) in all.

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